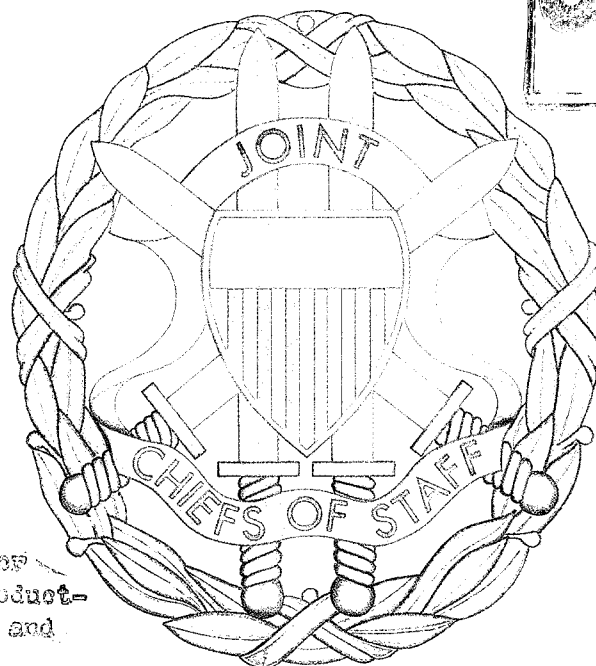
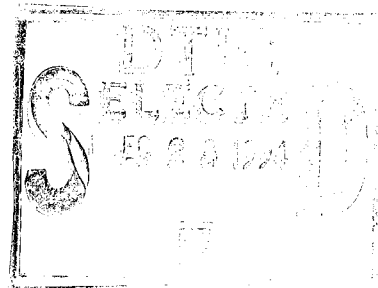


# JOINT MODELING AND SIMULATION EVOLUTIONARY OVERVIEW



\*Original contains color  
plates; All DTIC reproductions  
will be in black and  
white.



**THE JOINT STAFF**

19941215 232

FEBRUARY 1994

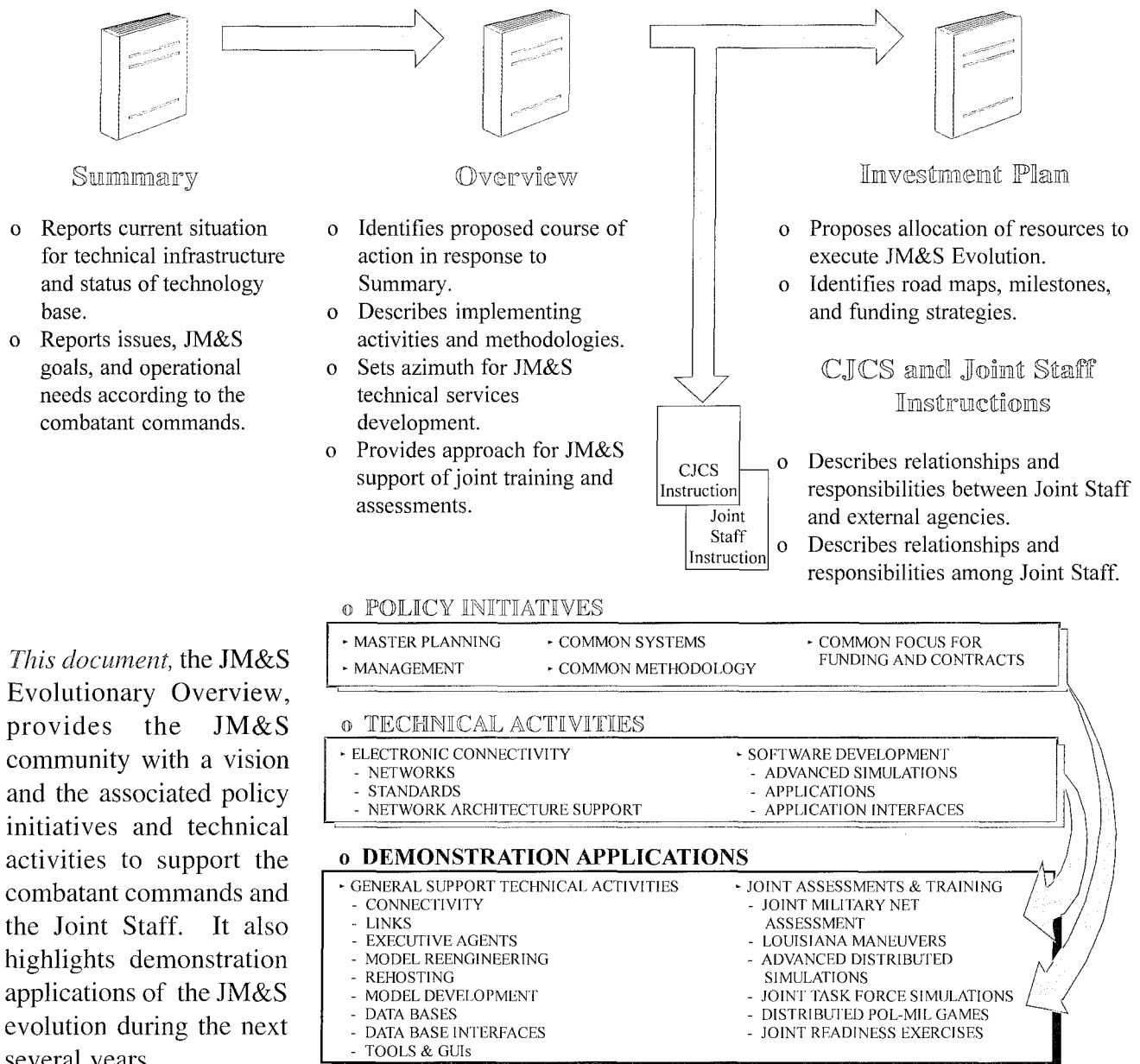
Deputy Director for Technical Operations  
Force Structure, Resources, and  
Assessment Directorate, J-8



# JM&S EVOLUTIONARY OVERVIEW

*Joint Models and Simulations (JM&S) are those models and simulations (M&S) that represent joint and Service forces, capabilities, materials, and services used in the joint environment or by two or more of the Military Services. The JM&S Evolutionary Overview is a key element of the JM&S Master Planning Process, which develops JM&S technologies and policies.*

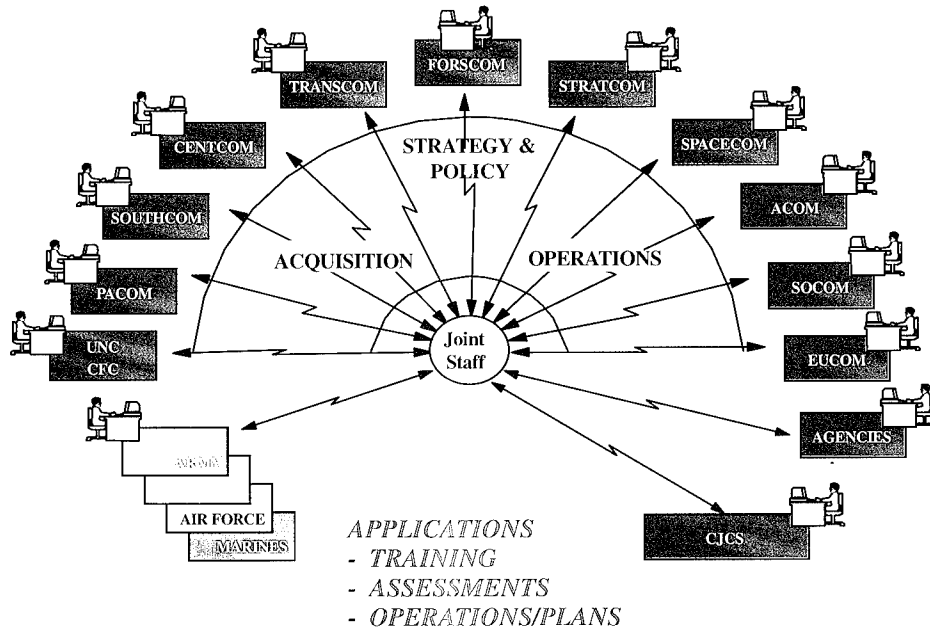
The Master Planning process provides for oversight and coordination of all JM&S activities and serves as the foundation for investment strategies and life-cycle management decisions.



This document, the JM&S Evolutionary Overview, provides the JM&S community with a vision and the associated policy initiatives and technical activities to support the combatant commands and the Joint Staff. It also highlights demonstration applications of the JM&S evolution during the next several years.

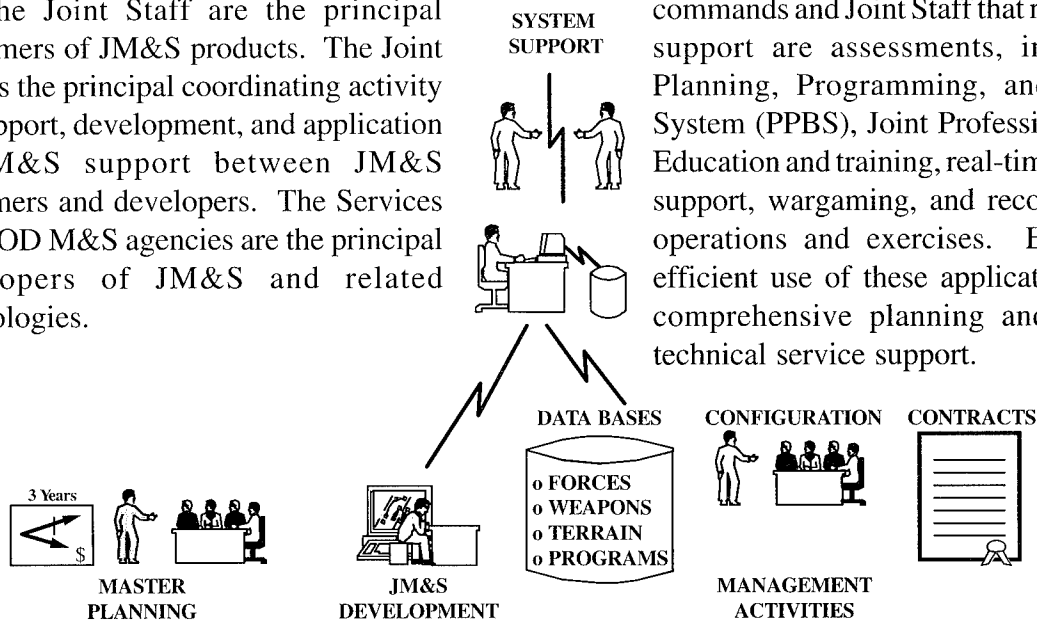
# JM&S COMMUNITY

*The JM&S community consists of agencies and activities in the Joint Staff, the combatant commands, and the Department of Defense who use M&S to accomplish their missions, and the Services, when providing M&S support to other Services or the joint community.*



*Community.* The combatant commands and the Joint Staff are the principal consumers of JM&S products. The Joint Staff is the principal coordinating activity for support, development, and application of JM&S support between JM&S customers and developers. The Services and DOD M&S agencies are the principal developers of JM&S and related technologies.

*Need.* The primary functions of the combatant commands and Joint Staff that require JM&S support are assessments, inputs to the Planning, Programming, and Budgeting System (PPBS), Joint Professional Military Education and training, real-time operational support, wargaming, and reconstruction of operations and exercises. Effective and efficient use of these applications requires comprehensive planning and responsive technical service support.



## JM&S TECHNICAL SERVICE SUPPORT BASE

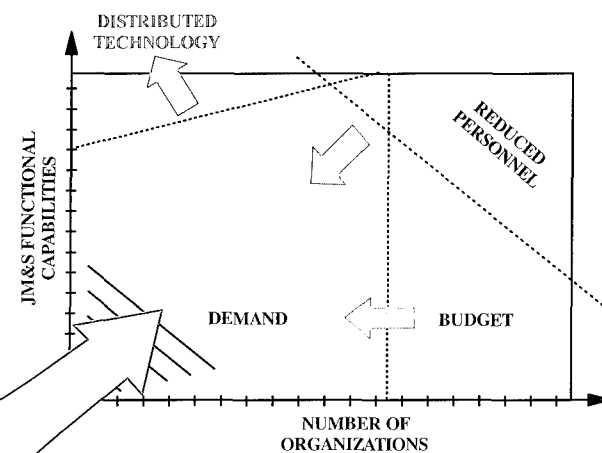
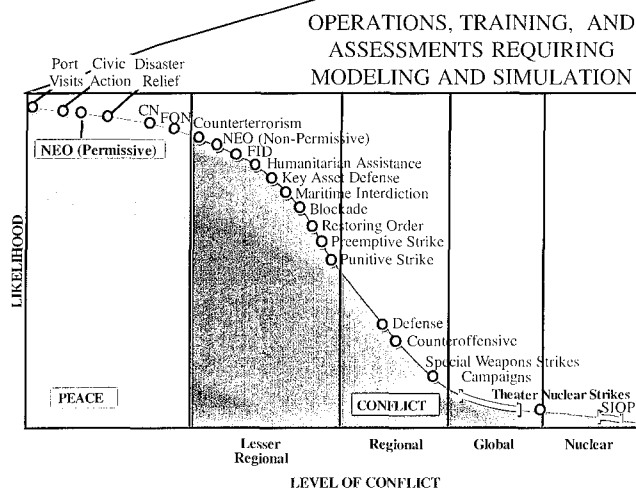
# JM&S CHALLENGES

*The JM&S community must acquire and apply distributed M&S technology effectively and efficiently to support the Joint Staff and the combatant commands to meet their mission requirements within the constraints imposed by shrinking DOD resources.*

In the past, DOD's wargaming and assessment infrastructure was a heterogeneous mixture of systems and applications independently developed, supported, and operated by the combatant commands, Services, and Joint Staff. The JM&S community contained many independent activities supporting the Joint Staff, but not each other. The JM&S Summary, published on 1 October 1992, showed a wide variety of existing applications and hardware, with considerable overlap in requirements.

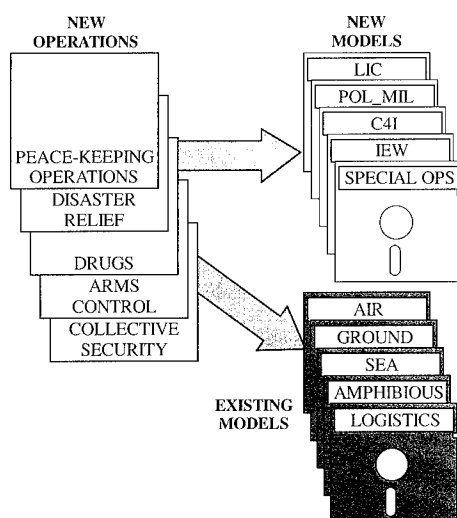
The end of the Cold War brought renewed emphasis on those missions and contingencies at the lower levels of conflict but with higher likelihood of occurrence--ranging from drug interdiction, peacekeeping, and disaster relief, through low and mid-intensity conflict. This

increased emphasis on a diversity of operations requires a significant augmentation for M&S--the modeling of smaller operations involving rapid force deployments and the leverage of emerging technologies to achieve quick and favorable resolution of contingencies.



Several combatant commands have strong M&S efforts, but the increased support demands caused by more missions of greater diversity will strain existing resources. New, improved, or reengineered models and simulations are required to support process assessments of force generation; command, control, communications, computers, and intelligence (C4I); ballistic missile defense; electronic warfare; nonlethal combat; low intensity conflict; and special operations. Models and simulations are also needed for political, economic, ethnic, and religious effects on international security and their interactions with military effects and each other. The Joint Staff is working with the

intelligence community, Services, and combatant commands to fully portray opposing force capability in M&S activities as required. The large number of site-unique models already in use, combined with the potential proliferation of new models, present challenges in planning,

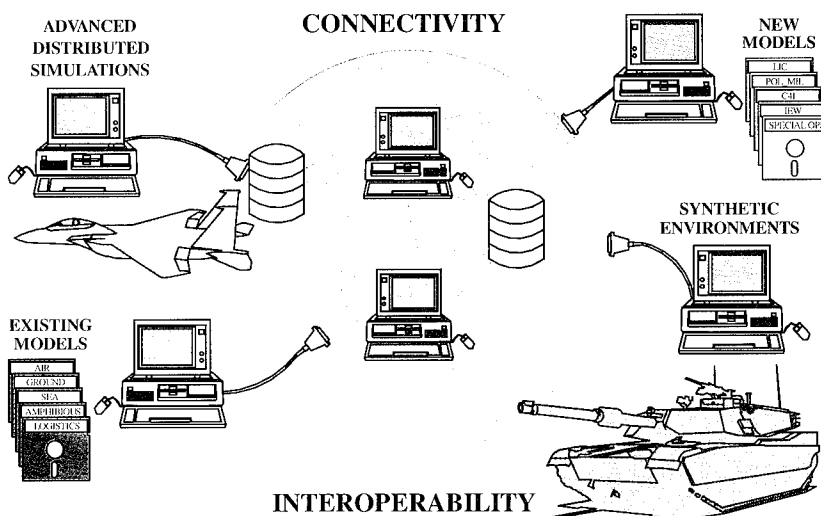


development, and configuration management. However, resources for training and operational support are being reduced, hindering the individual commands from enhancing their own M&S capabilities with internal resources. Unfortunately, the resources of JM&S general support activities are also shrinking with reductions in budgets, personnel, and facilities.

Further challenges result from the rapid advance of technology and corresponding DOD standards and initiatives. DOD initiatives on Corporate Information Management (CIM), including open architectures, applications portability and connectivity, and protocol standards will affect the entire JM&S community. Modern networking activities such as the Defense Simulation Internet (DSI) will

enable distributed processing of M&S over a wide-area. However, most current Service simulation models were not designed to meet JM&S requirements and most require different terrain and force data bases. In addition, logistic, intelligence sensor, and political-military (pol-mil) analytic models do not generally interact with combat models. New concepts in JM&S activities using synthetic environments and advanced distributed simulations are being developed and implemented, but current simulations are not generally compatible with existing C2 systems, and users are often required to participate in simulation-supported events away from normal operational areas using unfamiliar and single-use equipment.

M&S provides a set of tools and techniques to solve problems and enhance operational capabilities. The increasing need for JM&S support, combined with shrinking resources and a complex, evolving technical environment, requires a common vision and common goals, objectives, and investment strategy to properly allocate scarce resources in an efficient manner. While evolving to a more efficient, responsive structure, the JM&S community must continue to provide the broad, outstanding support that has become expected by the expanding customer base.



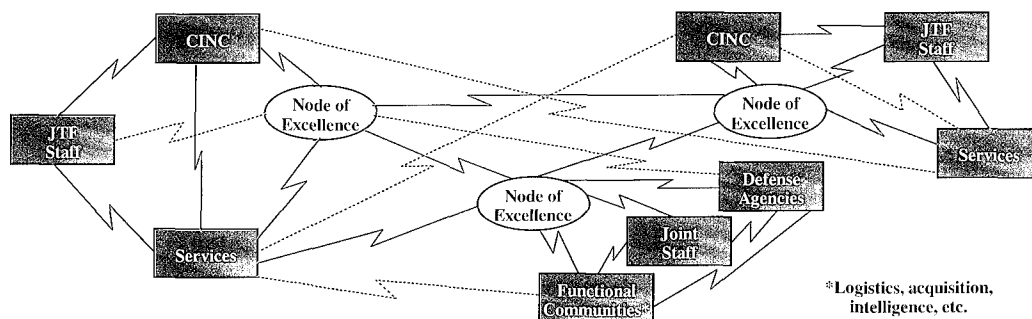
# JM&S EVOLUTIONARY VISION

*The JM&S Evolutionary Overview envisions an evolution from support provided by self-contained, specialized M&S centers to a distributed network of centers and users that allow the exchange of M&S capabilities across the JM&S community.*

The evolutionary vision is a coordinated development of JM&S to leverage both the considerable investment in existing capabilities and the competence that exists in widespread centers of excellence for key warfighting tasks. The core concept is centralized management with decentralized execution, called Distributed Models and Simulations (DMS). The combatant commands have established strong internal M&S resources, and the Services maintain robust centers that develop, use, and maintain models and simulations. The evolution of JM&S is envisioned to migrate to the establishment of "virtual" JM&S centers built up from the nodes of excellence that are the current widely distributed M&S centers (e.g., USTRANSCOM, Warrior Preparation Center, Korea Battle Simulation Center, National Simulation Center, Blue Flag, Joint Task Force Simulation Center, Joint Warfighting Center, National Test Facility, Advanced Research Center, etc.). DMS will match the core competencies of the various JM&S centers with other centers and form collaborative webs of "suppliers and customers" to meet the specific needs of the combatant commands and the Joint Staff. Each center will specialize in doing part of the overall system very well.

The nodes of excellence will serve as executive agents for the more generalized modeled representations. They will be capable of supporting operations with other nodes on a coordinated basis, readily available through existing, non-dedicated connectivity pipelines. The tailoring of specific JM&S capabilities from distributed centers, through fully operational distributed networks, to support specific requirements at any node is a concept called DMS pinpoint support. This netted pooling of expertise will (1) allow M&S to evolve as the Service/combatant command needs and capabilities evolve; (2) maximize effectiveness by allowing the Service and combatant command areas of expertise to directly affect the tools available for joint taskings; and (3) maximize efficiency by enabling multiple, nonredundant, parallel operations that will help reduce the overhead of traditional, stand-alone centers and reduce competition for resources, assets, and application acceptance.

The Joint Staff's role in the vision is to facilitate and support the evolution of the DMS capability by identifying issues and activities requiring collaborative M&S application or funding assis-



**DISTRIBUTED MODELS AND SIMULATION**

tance. The Joint Staff will do this with policy initiatives, technical activities, and demonstration applications that simultaneously support a near-term need and serve as a base to demonstrate and expand evolving JM&S capabilities.

*Policy Initiatives* will be those master planning actions taken by the Joint Staff that establish policy for both resource allocation and JM&S community and applications management and development. Although the combatant commands and Services will be free to develop or procure products or services they determine to be in their best interests, Joint Staff funding assistance and contract vehicles will be available only for those activities that support the JM&S evolutionary vision. The hardware and software architectures and joint models supported will be those that best meet the needs of the community, are useable by more than one user and for more than one application, and allow for future expansion. The allocation of Joint Staff and OSD resources to execute this evolutionary vision will be expressed in the JM&S Investment Plan. The near-term investment strategy will identify and capitalize on areas where substantial hardware and software reuse is possible, both within and across JM&S applications domains. The long-term strategy will lead to creation of an interchangeable components base. The goal is to move the JM&S community from its current "reinvent the software" cycle to a process-driven, domain-specific, architecture-centric, library-based way of constructing software that will operate in open-system environments on non-vendor-specific equipment.

*Technical Activities* will provide the foundation and framework to support DMS. Electronic connectivity will provide the means to distribute M&S to support the combatant commands, Services, and Joint Staff. Connectivity policy and standards, documentation of network architectures, and supportive hardware configurations

will be established by the Joint Staff, OSD, Advanced Research Projects Agency (ARPA), and Defense Information Systems Agency (DISA) in coordination with the combatant commands and Services. Interoperability with Global Command and Control System (GCCS) standards and protocols will link the JM&S community and the warfighters they support. Activities in software development will focus on advanced simulations, applications, and data and applications interfaces. Synthetic environments, virtual reality technologies, and integrated, multi-level simulations will open JM&S support to many more, and previously unsupported, customers. Integrated simulations will be fostered with the development and use of distributed, interoperable, open-system architectures. Model development and reengineering and a JM&S tools program will facilitate the development of modeling, analysis, and exercise aids. Establishment of common and reusable data bases and consistent and improved user interfaces and graphical user interfaces (GUI) will facilitate the sharing of M&S.

*Demonstration Applications* will be those activities that stretch existing capabilities in the direction of the evolutionary vision and simultaneously address near-term needs. Specific demonstrations will be identified for general support technical activities, such as connectivity, links, model reengineering, rehosting, configuration management, data bases, tools, and GUIs. DMS pinpoint support will be used to collaborate in near-term assessments of policy, strategy, doctrine, logistics, and operational concepts. It will also be demonstrated in support of the force structure, procurement, operations, and system deployment decision processes. In addition, the JM&S community will supplement the combatant commands indigenous M&S capabilities with DMS pinpoint support, provided through distributed technologies, to meet joint training objectives.



## JM&S POLICY INITIATIVES

*Policy initiatives, including master planning and management, common systems and methodologies, and contract and funding focus, will nurture M&S development, connectivity, and interoperability to provide efficient, quality DMS pinpoint support.*

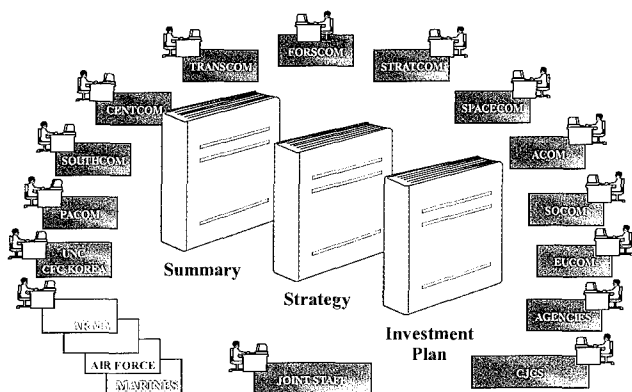
All policy initiatives will comply with DOD Directive 5000.59, DOD Modeling and Simulation (M&S) Management. They will include the complete spectrum of planning, development, and management activities to provide members of the JM&S community required M&S capabilities through a responsive and accessible distributed network with minimum coordination. A strong and continuous interface between the customer and supporting agency will be maintained to ensure support requirements are being met. The policy initiatives will provide:

- o Master planning and management for a broad-based strategic vision.
- o Common systems for identical functions, developed and maintained according to common methodologies.
- o A common focus for contracts and funding.

*Master Planning.* The JM&S Master Planning Process and subsidiary planning activities will provide direction for JM&S developments, investments, and operations management to achieve the goals described by this evolutionary vision and implement the concept of DMS pinpoint support. The investment plan will define, docu-

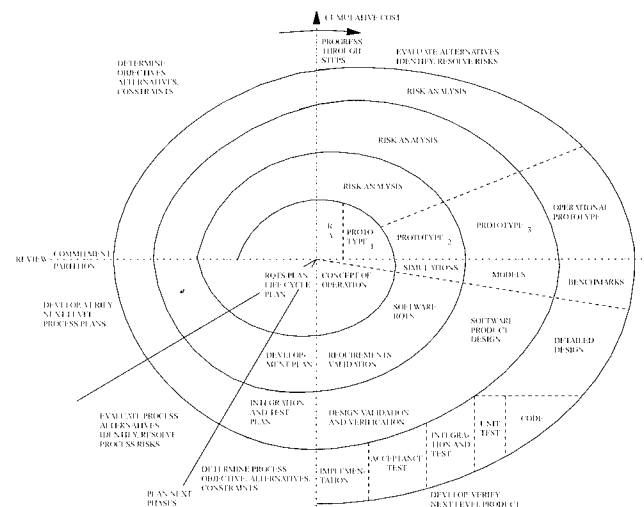
ment, and allocate resources towards goals, objectives, and strategies for future development, maintenance, and operation of JM&S. Broad-based participation during periodic reviews of the JM&S Summary, Evolutionary Overview, and Investment Plan will assure the allocation of resources is productive.

*Management.* The JM&S Community will receive distributed support and participate in its policy development. Life-cycle management processes will be maintained in accordance with DOD directives. The Services will be encouraged to build and maintain DMS-compliant models for assessments and training, become executive agents for specific applications, and assume life-cycle responsibilities, including configuration management, for development of M&S with joint applications. Configuration management pronency will be established for each Service-developed and joint community-developed JM&S. If the applications for the Service-developed M&S are or become common to multiple mission-areas, the applicable joint community agencies will become members of the configuration control board process for oversight purposes. Advanced distributed simulations will be demonstrated in joint activities and exercises to illustrate their capabilities. Combatant commands will be solicited as "demanding customers" while the Joint Staff surveys requirements in support of decision milestones and joint accreditation. Distributed system support will be centrally managed, developed, and maintained by selected M&S agencies and available to the entire JM&S community via distributed networks. This distributed capability will be a cooperative venture among the JM&S



community, facilitated by the Joint Staff; in the event of competing interests, the Services will remain the final arbiter for use of Service resources. Centralized sourcing and maintenance of common data bases required for joint training and assessments will also be developed and made available via distributed networks. The Joint Modeling and Simulation Executive Panel (JMSEP) will provide a forum for JM&S community interaction and cooperation. The Joint Warfighting Center (JWFC), under the direction of the Joint Staff J-7, will assist the JM&S community in its preparation for joint warfare by providing core expertise to define, obtain, prepare, and apply appropriate modeling and simulation technology and war gaming techniques to support exercise and training activities. JWFC will emphasize the use of distributed technology as that technology becomes available.

requirements for distributed networks will be achieved by encouraging JM&S procurement consistent with standards emerging from the development process. The Department of Defense will develop, and the JM&S community will use, a communications and computing infrastructure based on open systems and systems transparency. This will include, but is not limited to, operating systems, data base management, data interchange, network services, and user interfaces. "Stovepipe" systems and "islands of automation" will be replaced with interconnected open systems that can share data and other resources. This will provide the basis for development of common applications across networks of heterogeneous hardware and software platforms. JM&S conforming applications will be interoperable between mission-area applications and portable across mission-areas, allowing for movement with minimal modifications.



Connectivity will be used to get new models into the hands of users quickly and, equally important, to get more user input into the development

process early. Life-cycle management will normally be the responsibility of the application executive agent, with the Services being encouraged to assume life cycle responsibilities for many JM&S applications in coordination with sponsoring combatant commands. All members of the affected community will have input to the configuration control board to identify, define, and quantify their specific requirements.

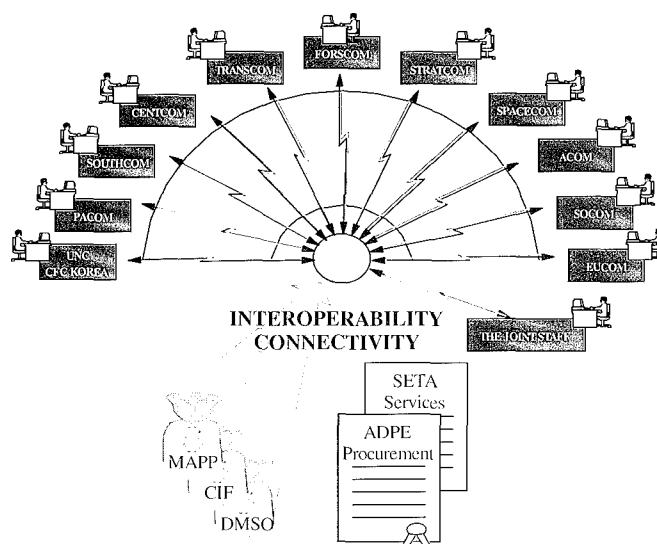
Each DOD component will establish verification, validation, and accreditation policies and procedures for the M&S applications that it manages and will be the final authority concerning the validation and accreditation of representations of its own forces and capabilities in joint and common M&S. Each component will be responsive to the other components in ensuring that forces are appropriately represented in the development of joint and common-use M&S. The Joint Staff and the JM&S community will support and interact with the C4I for the Warrior (C4IFTW) initiative, Defense Modeling and Simulation Office (DMSO) activities, the CIM philosophy, and future DOD automated information system standardization efforts.

*Common Focus for Contracts and Funding.* The Joint Staff will assist the JM&S community to define M&S requirements, develop and reengineer joint interfaces, and support joint applications of Service M&S. The Joint Staff will manage multiyear, incrementally funded, quick-response umbrella contracts for systems engineering and technical assistance (SETA) and automated data-processing equipment (ADPE) to support interoperability and connectivity requirements.

JM&S community members, using the SETA contract, would define specific task requirements, budgets, and schedules for work at customer specified locations and provide direct manage-

ment control of contractor teams. An indefinite delivery/indefinite quantity, multiyear contract will enable JM&S community members to buy ADPE--hardware, software, and communications --from commercial off-the-shelf sources. This contract will feature quick response and centralized administration. Products on contract will be based on standardization, interoperability, and commonality requirements of DMS.

Contract vehicles or funding will be available to the JM&S community for projects consistent with and supportive of the DMS pinpoint support concept. Funding will be available through the Modern Aids to Planning Program (MAPP) and other study programs. All funding (in excess of combatant command operating funds) in support of JM&S procurement, development, and applications will be coordinated with a single focal point on the Joint Staff. Funds will normally be used for "bridge" money to initiate high-priority projects until appropriations are obtained through the PPBS. Additional funds may be available through DMSO for M&S initiatives approved by the DOD Executive Council for Modeling and Simulations (EXCIMS) and through the CINC Initiative Fund (CIF) for those M&S initiatives considered part of a functional area, such as C2, joint exercises, or force training.



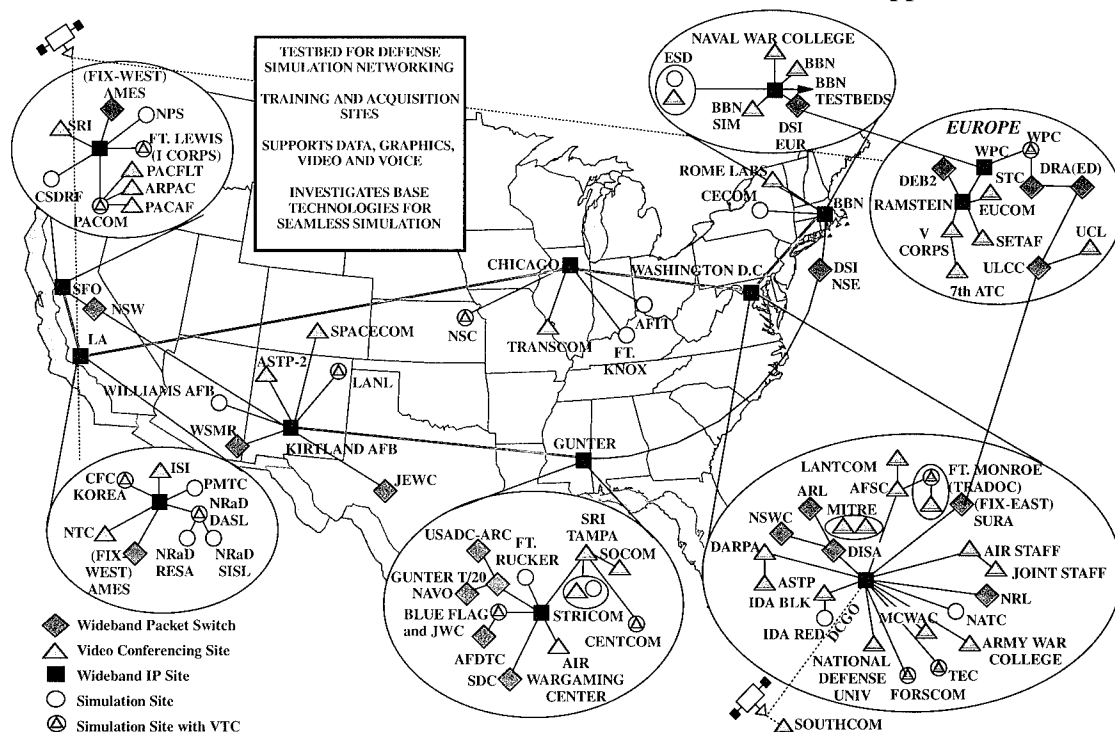
# JM&S TECHNICAL ACTIVITIES

*The members of the JM&S community will migrate to Distributed Models and Simulations pinpoint support--JM&S capabilities tailored for specific requirements exchanged through fully operational distributed networks--to supplement their indigenous M&S capabilities. Technical activities in electronic connectivity and software development will facilitate this migration.*

Technical activities include the programs and actions that the JM&S community will initiate, support, or interface with in order for the evolutionary vision to become a reality. As the Joint Staff, Services, and other DOD agencies move into the future, the programs and activities will naturally evolve, but will generally fall into the categories of:

- o Electronic connectivity, including networks, common standards, and network architecture support activities.
- o Software development, including advanced simulation methods, applications, and application interfaces.

*Electronic Connectivity.* The development and fielding of distributed networks is key to the concept of DMS pinpoint support. During the next 5 years, the Defense Simulation Internet (DSI) will be developed and matured under the control of ARPA. DSI will distribute the full spectrum of M&S capabilities, network management, and operations support to supplement indigenous capabilities at nodes across the JM&S community. Implementation and operation of DSI will avoid the cost of establishing and maintaining unnecessary, duplicative M&S capabilities by allowing access to any capability in the JM&S community. DSI will also provide a testbed for JM&S application's connectivity



## DEFENSE SIMULATION INTERNET

(Plan as of 13 Jan 93)

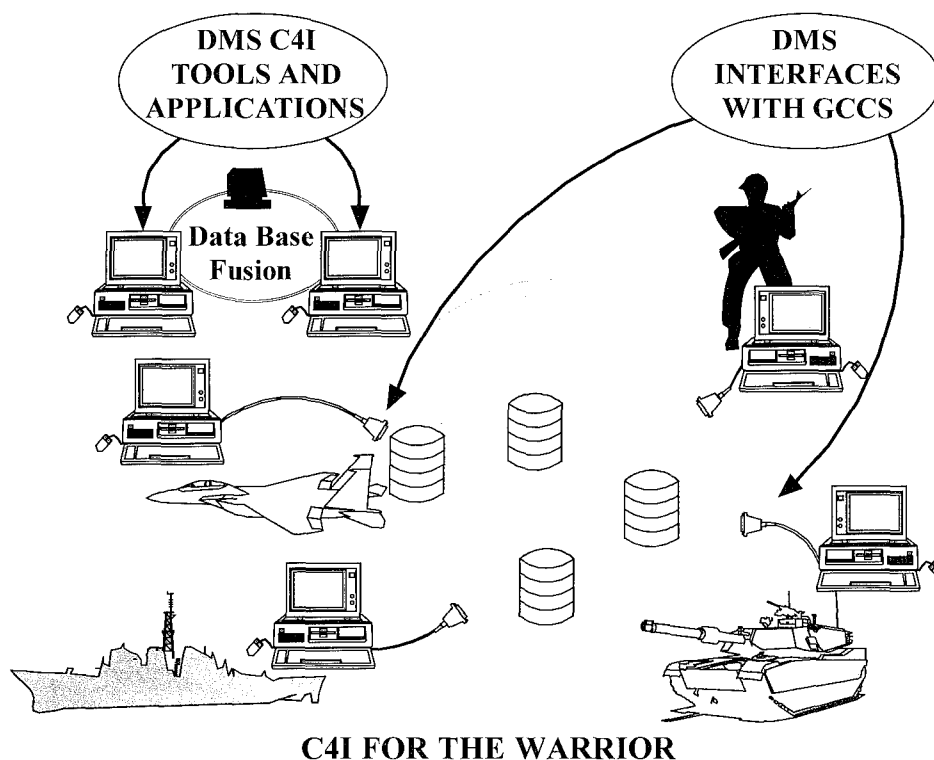
and interoperability requirements. DSI will migrate from its current prototype network to the Defense Information Systems Network (DISN) under combined ARPA and DISA program management.

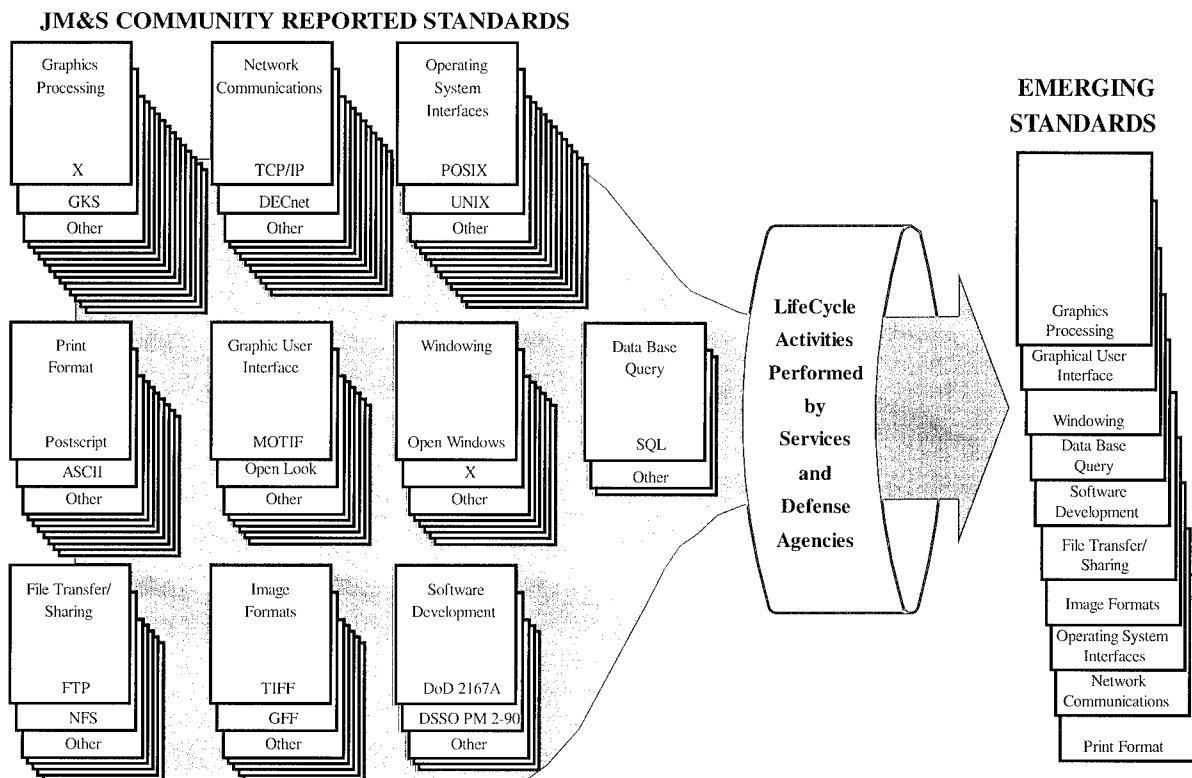
Joint exercises and assessment activities will provide the backdrop for the evolution of DSI from its current development state to a fully operational status. Common hardware, software, protocols, and applications will be connected to DSI on wideband circuits sufficient to meet usage projected for the exercises. ARPA will be responsible for the technical aspects and operation of DSI, JWFC will be responsible for scheduling of DMS and ensuring that appropriate JM&S interfaces are established, and the Joint Staff will be responsible for resolving scheduling conflicts.

Connectivity among the Joint Staff, combatant commands, and warfighters of all the Services will be linked and supported through the Joint Staff J-6 program, C4I for the Warrior (C4IFTW).

The C4IFTW concept, as implemented by GCCS, provides an interoperable, fully integrated, widely distributed, and user-driven network to which the warfighter may simply "plug in" to gain access. This network provides seamless, secure connectivity through multiple, highly flexible nodes to other operational elements and data bases (which are automatically updated and from which desired information can be pulled).

Joint C4I training objectives will encompass C4IFTW as the concept is implemented and fielded. DMS support of these training objectives requires the development of JM&S and DSI applications that can interact with the fusion processes of GCCS and meet the connectivity requirements of its architecture. Each phase of the C4IFTW--Quick Fix (develop translators to achieve interoperability between existing systems), Mid-Term (implement a common Joint wide-area network operating environment and migrate to commercial national and international standards), and Objective (mature and evolve)--requires parallel DMS development.





*Standards.* Interoperability and connectivity are essential to the concept of DMS pinpoint support. An application incompatible with the JM&S operating environment effectively confines itself to its origin and cannot be made available to the JM&S community through DMS pinpoint support. Many standards in every software category are now used by the JM&S community, including data formats, languages, graphics, operating system interfaces, and network communications. These standards provide the basis for interoperability while supporting a wide variety of users and applications. Key standards are open systems and software design documentation.

Standards will continue to emerge and evolve as the state of the art is continually pushed forward and new uses for M&S are discovered. Compliance with current and emerging international, federal, and other DOD standards, and the establishment of new JM&S standards will aid in

achieving the desired interoperability. Operating environments will be standardized in the course of development of new tools and applications by their acceptance in the JM&S and civilian communities. This approach avoids premature adoption of standards that might hinder research of new technologies and, instead, steers to standardization in the wake of successful development. Both new development and reengineered models and operating environments will comply with joint interoperability and connectivity requirements for DMS pinpoint support. Standards for specific functionality will vary with the intended use of each model.

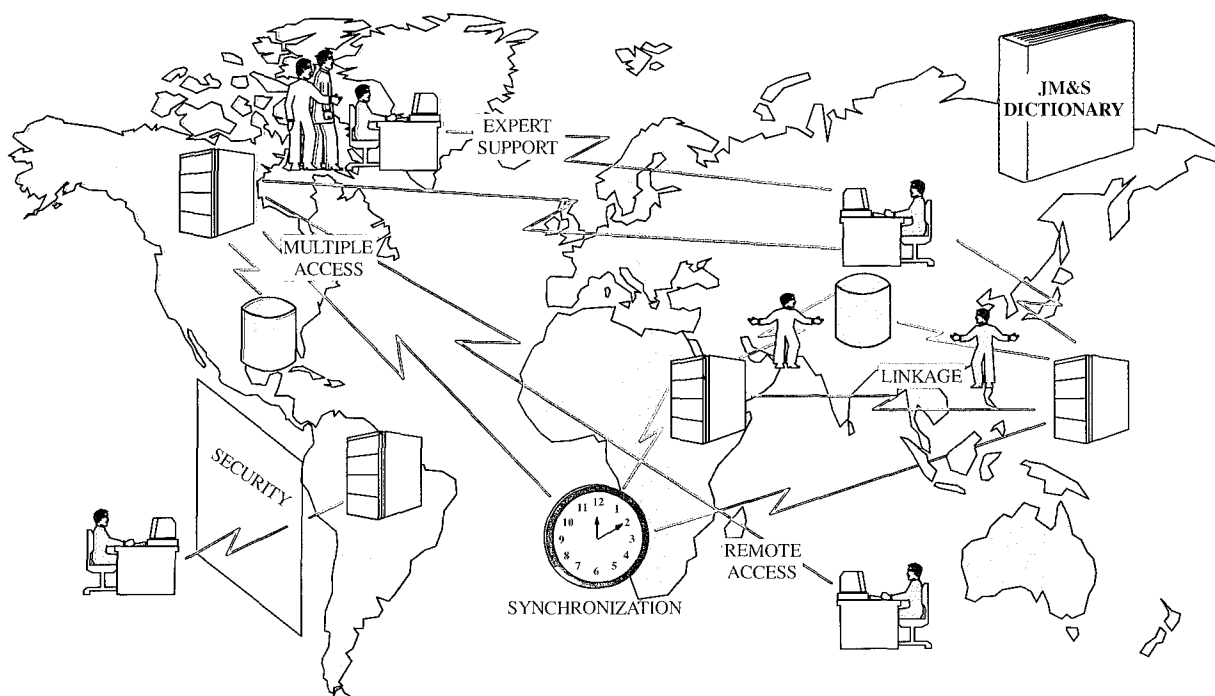
*Network Architecture Support Activities.* The successful operation of DMS pinpoint support requires the integration of distributed system support and network capabilities. General system support will be continuously on line; other support will be tailored and distributed to specific assessment and training events. The figure

below illustrates the capabilities and services must be available on joint distributed networks.

Security requirements of diverse models, data bases, and communications and computer networks compound the technical problems facing the JM&S community's evolution to DMS. Most classified M&S operating environments are currently protected by system high security measures. The DMS environment will require a shared, integrated, encrypted, multimedia network capable of operating at multiple levels of security to ensure data confidentiality, data integrity, and access control. Close cooperation between the Defense M&S community and the National Security Agency will be required to facilitate development of hardware and supporting doctrine for multiple levels of security. Security improvements will be realized by applying consistent policies throughout the Department of Defense, such as uniform system security accreditation procedures and consistent security interfaces. Security features will have

similar characteristics across mission area applications. Not all mission area applications will need the same security features, but the features will be consistent where they are used. Users will see the same security labels in a common format and manage them in the same way. User login will be consistent across applications.

*Software Developments.* Activities in software development will focus on advanced simulations, applications, and applications interfaces. Advanced simulations include applications of virtual reality, synthetic environments, and integrated, multilevel simulations. Virtual reality refers to simulations with interfaces that respond to user input as if the user's physical environment were actually the item simulated. Existing system simulators that attempt virtual reality are gunnery trainers, driver trainers, and cockpit simulators. As item level representations, these are unlikely to be Joint by themselves. However, the electronic netting of virtual reality simulators, particularly with ones of different natures

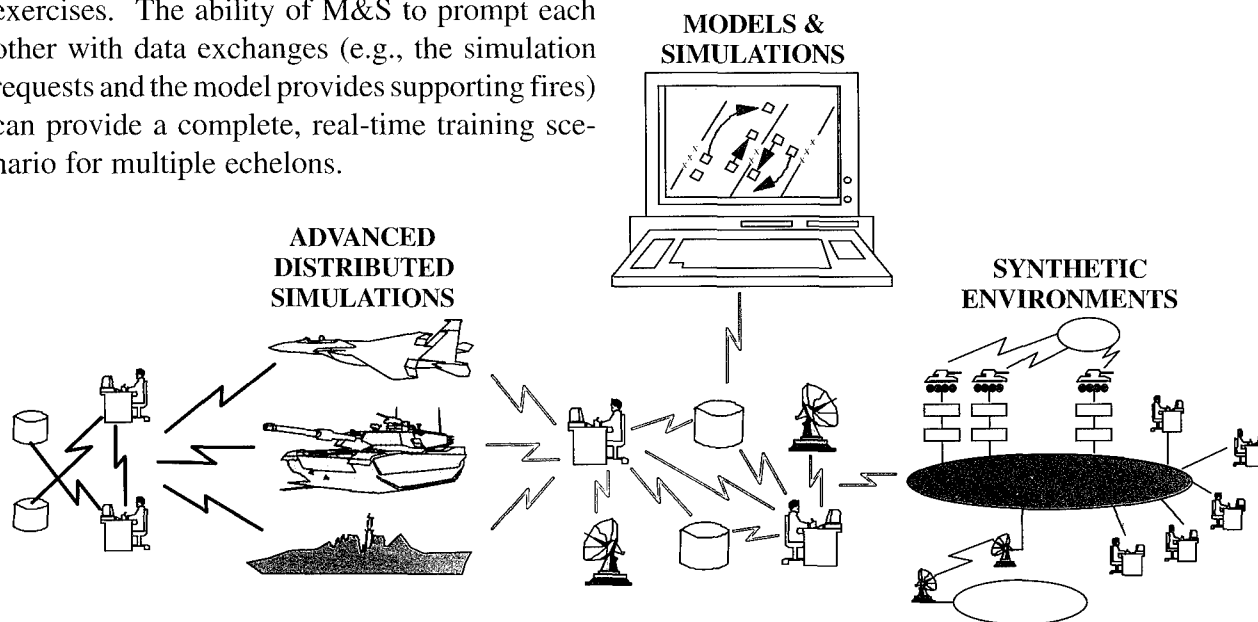


**DISTRIBUTED SYSTEM SUPPORT**

(such as air defense and aircraft) and/or the netting with application software simulations, offers much promise. Constrained by the validity of the virtual reality simulators and their interfaces, this developing technology offers the JM&S community the opportunity to make human training and performance an integral part of higher-level training and analysis activities.

Synthetic environments can be represented by both the networking above and the interface instrumentation of actual combat vehicles to represent weapons effects, such as Air Force Red Flag exercises or the Army exercises at Fort Irwin, CA and other combat training centers. Synthetic environments can be used in research and development to refine requirements, test concepts, and measure human performance. System benefits can be estimated before expensive prototypes are designed and developed. Data generated by a synthetic environment can be collected and replicated easier than data from a field test. Finally, related issues such as logistics or command and control can be investigated concurrently. Similarly, synthetic environments can be used to train staff and units simultaneously, a methodology currently limited to field exercises. The ability of M&S to prompt each other with data exchanges (e.g., the simulation requests and the model provides supporting fires) can provide a complete, real-time training scenario for multiple echelons.

Integrated, multilevel simulations promise to offer the JM&S communities the scope of large scale M&S with the credible detail of much more focused M&S and alleviate reasonable concerns that critical details are inappropriately aggregated or assumed away in theater-level studies. These simulations will electronically integrate results from different venues (computer models, instrumented troop exercises, item level simulations) or integrate existing models (e.g., deployment models, airstrike models, and unit ground combat models to interact and support a theater-level model.) Some of this work will result from standard interfaces or the adoption of interface protocols, such as the Aggregate Level Simulation Protocol (ALSP). DMSO, ARPA, and the Institute for Simulation and Training are jointly sponsoring an effort, Distributed Interactive Simulation (DIS), to establish protocol standards for the simulations community. The Institute of Electrical and Electronic Engineers (IEEE) Standard 1278-1993, approved in March 1993, provides the first in a series of standards for linking currently available simulators and future production devices so that they will interoperate on standard simulated battlefields in the future. The goal is to create a virtual





environment (terrain, graphics, and communications) that has entry standards for software developers that will ensure future simulations are functionally interactive. Potential applications of virtual reality, synthetic environments, and integrated, multilevel simulation techniques will be determined as the technologies are further explored, defined, and developed. Investment of joint resources will be driven by the potential for near-term value added.

*Applications.* The development of software applications is critical to the success of the JM&S evolution. Full migration to DMS will require the reengineering of existing applications and the development of new models and common tools. The JM&S community will rely on and coordinate with the Services for these activities. Leveraging low-risk, high-payoff technologies will be encouraged. Model development and reengineering will focus on reuse in specific domains, exploiting those domains to support reuse-in-the-large. Efforts will employ reuse-oriented architectures to spur investment in components to populate the architectures. They will also use an interconnected network of reuse libraries to drive the capture, storage, and reuse of components within and across domains. *The objective is systemic, not opportunistic, reuse.*

When possible, existing models will be reengineered to meet new model requirements. Reengineering can be used to reduce software errors, improve model efficiency, and obtain higher model resolution of a particular subject or operational aspect while requiring less resources than new model development. For those applications that must be custom developed, incorporating software reuse into the development methodology will reduce the amount of software to be developed and add to the inventory of software suitable for reuse by other systems. The JM&S Evolutionary Overview

emphasizes the goals of developing modular applications and promoting software reuse to support the broad range of activities that are integral to any organization. To satisfy these goals, M&S development will, in many respects, become an integration activity.

*Applications Interfaces.* To fully exploit the opportunities DMS offers will require common and reusable data bases and consistent applications interfaces. Centralization and automation of data collection and reduction will reduce overhead and provide a common data base for joint assessments and training. JM&S users will access centralized data bases through distributed networks to rapidly prepare data bases for DMS applications. Automated external interfaces to centrally maintained data sources will reduce data management requirements and improve data accuracy. Data will be shared across the Department of Defense in the context of security and operational considerations and comply with DOD standards. Concepts formulated during the development of the Conventional Force Data Base (CFDB), Master Simulation Data System (MSDS), and the Operations Analysis and System Interface System (OASIS) will be expanded to establish centralized sourcing and maintenance of data and will adhere to OSD CIM standards.

User interfaces or GUIs for new or reengineered models should be industry standard interfaces. Standardized GUIs provide a consistent and intuitive graphical user interface with familiar windows, buttons, and standardized icons instead of complicated commands. These features allow everything to look the same across multiple platforms; it does not matter what machines, operating systems, or applications are used. Everything works the same, so users spend less time learning applications and more time using them to the fullest potential.

## JM&S DEMONSTRATION APPLICATIONS

---

*The JM&S community is participating in activities that stretch the existing M&S capabilities in the direction of this evolutionary vision while simultaneously addressing near-term needs. These activities fall into two primary areas--general support technical activities and the use of DMS pinpoint support for collaborative assessments and support of joint training objectives.*

*General Support Technical Activities.* Members of the JM&S community are pursuing initiatives that will materially contribute to the underlying technical support base that must be in place for the concept of DMS to be successful. The following are examples of some of these activities:

*Connectivity.* The cultivation of DSI to support the full spectrum of JM&S requirements depends on a network architecture unified by ARPA that is flexible and can operate, when needed, at low recurring cost. The DSI long-term objective is to link its M&S capabilities into DISN.

The initial JM&S DSI connectivity consists of three classified subnets (DSISS-A, Secret NOFORN; DSISS-N, Secret NATO; and DSSIS-K Secret ROK). The Joint Staff is working with ARPA to advance JM&S interactivity by creating a virtual sub-network to support the following:

- o Simultaneous, multisite participation.
- o Distributed gaming using remote site login.
- o The ability to select, create, query, update, and destroy distributed data bases at a central location with remote, secure access.
- o Shared workstation conferencing using interactive audio, text, and graphics.
- o Rapid information exchange.
- o High-speed digital transmission.
- o Electronic mail and interactive phone capability.
- o Host-to-host connectivity.
- o Desktop multiparty video teleconferencing.

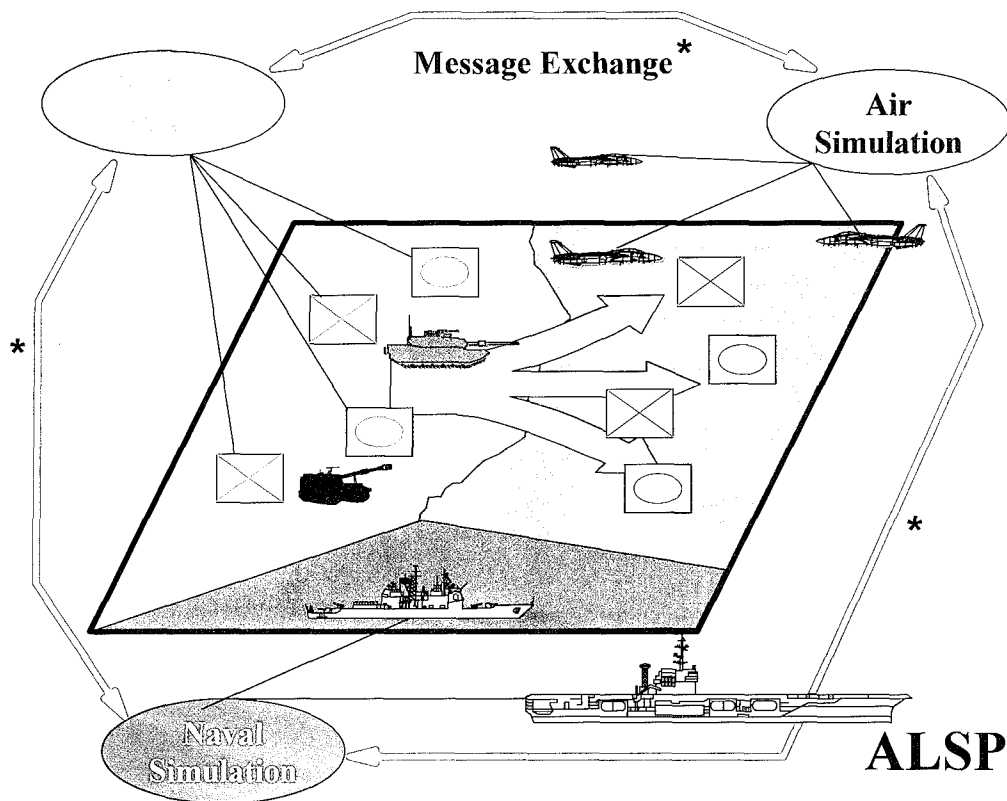
*Links.* Several mechanisms are being pursued to link existing legacy models (Service-specific used and operated) into a joint environment. These include object-oriented model environments, protocols, and establishment of interface routines to create compatible input-output files. These near-term efforts are required to develop joint models for combatant command and Joint Staff use.

Aggregate Level Simulation Protocol (ALSP) is established to link existing, accepted training models in a confederation where they can interact with each other's battlefield "objects" (systems, units, etc.). Simulations in the confederation communicate with each other through standard protocol messages that describe the objects to be shared and the interactions among those objects. The protocol maintains global time consistency among the confederation members and ensures unique attributes ownership of the objects. This approach has three distinct advantages:

- o It preserves Service-unique aspects of joint operations by using Service-developed simulations to model their respective operations.
- o Combatant command and Service staffs can exercise and train in a joint environment using familiar, Service-approved simulations.
- o ALSP confederations can be operated in a distributed mode so that component staffs can support joint exercises from their home stations and operate their respective simulations in their own facilities.

The current ALSP confederation consists of a link between the Army's Corps Battle Simulation (CBS), the Air Force's Air Warfare Simulation (AWSIM), and the Navy's Research, Evaluation, and Systems Analysis Facility (RESA) model. This confederation supports and reports the results of air-to-surface and surface-to-air engagements, airlift of ground units, movement of acquisition radars and air defense units, and other events occurring both within and between the air, land, and sea environments represented. Examples are the results of TOMAHAWK Land Attack Missile (TLAM) engagements initiated in RESA against targets in CBS, engagement of TLAM by CBS ground-to-air weapons, and air-to-air engagement results of AWSIM F-15s and RESA F-14s against a Red attack initiated in AWSIM. The Army serves as executive agent for ALSP, and ongoing development includes the incorporation of the Army's Tactical Simulation model (TACSIM) and the Combat Service Support Training Simulation System (CSSTSS).

When this development is completed, the confederation will support and report intelligence provided by electronic and imagery sensors, supply and services functions, and the deployment, reception, and forward movement of units into the theater. The Air Force National Air and Space Warfare Model (NASM), when completed, will replace AWSIM as the Air Force contribution to the confederation. When the Enhanced Naval Warfare Gaming System (ENWGS) is delivered to the naval community, it will be adapted to use the protocols developed and tested in RESA and then become the designated naval model in the ALSP confederation. The designated Marine Corps model is the Marine Air Ground Task Force (MAGTF) Tactical Warfare Simulation (MTWS). When it is implemented, it will be adapted to use some of the naval protocols. Initial efforts are also underway to develop a ground-to-ground protocol for use by MTWS.



Under a Joint Staff initiative with DMSO funding, USTRANSCOM is pursuing a link strategy based on compatible files to demonstrate linked model output-input. The initial demonstration of end-to-end mobility modeling will link the Air Mobility Command's Mobility Analysis Support System (MASS), the OSD and Joint Staff's Model for Intertheater Deployment by Air and Sea (MIDAS), and the Army's Enhanced Logistical Intratheater Support Tool (ELIST) under the Analysis of Mobility Platform (AMP). Future plans are to add FORSCOM's Force Generation (FORCEGEN) and Force Flow (FORCEFLO) models and the Joint Flow and Analysis System for Transportation (JFAST), a Joint Operational Planning and Execution System (JOPES) model, for a true "Fort to Foxhole" model. FORCEFLO, under development by FORSCOM, models the movement of forces from "fort to port" and is designed to be interoperable and interactive with USTRANSCOM's Siting and Readiness Model (TSAR). FORSCOM and USTRANSCOM tested their mobility modeling capabilities in conjunction with ULCHI FOCUS LENS 93.

*Executive Agents.* Executive agents for joint models are responsible for life-cycle management and configuration control. Executive agents manage the entire integrated environment, consisting of the model, associated graphical interfaces, and utilities. They provide responsive configuration management processes that ensure the effective integration of simultaneously developed changes and modifications while satisfying the widely dispersed users. Configuration management is exercised through the Component Control Committee (CCC) with authorized voting members for each of the model-using combatant commands, the Services, and the Joint Staff. The executive agent representative chairs the CCC and manages development and maintenance of the model and its integrated environment for the entire user community. Other

model users participate as nonvoting members. To date, the Army has been established as the executive agent for the Tactical Warfare model (TACWAR), the Joint Conflict Model (JCM), and ALSP. The Navy has been designated executive agent for the Air Courses of Action Assessment Model (ACAAM). The Joint Staff, J-8, has established configuration management for M&S used by J-8 for which J-8 has oversight of development, maintenance, and configuration. Other users participate by submitting component change requests to the J-8 configuration control board through the responsible component project officer.

*Model Reengineering.* Many new M&S requirements can be met by reengineering and improving existing models, saving both time and resources. The Joint Warfighting Center developed JCM by reengineering the Lawrence Livermore National Laboratory version of the Janus model to include naval operations. The Joint Staff, J-4, is developing the Medical Planning and Execution System (MEPES), a component of the DOD Global Command and Control System (GCCS), by enhancing and adding functionality to the Medical Planning Module (MPM). MPM is the automated tool currently used by the medical planning community.

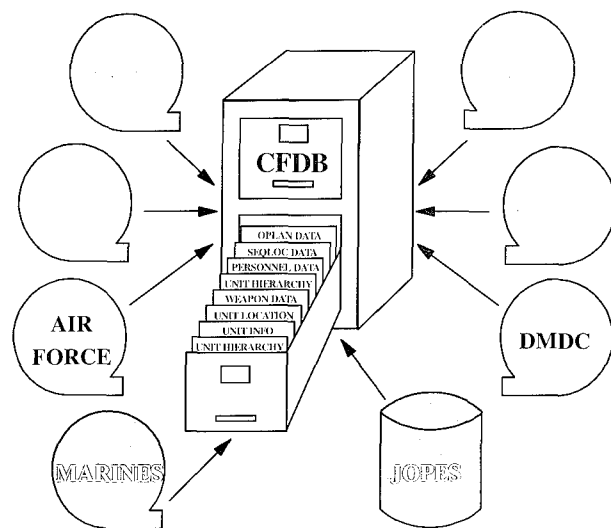
*Rehosting.* Many existing models operate on proprietary computer systems unavailable to other users. Rehosting to open-system architectures will enable new users to access these models and capitalize on the DMS concept. USCENTCOM is migrating TACWAR to the open systems SVR4 (System Five Release 4) environment for POSIX (Portable Operating System Interface Exchange) compliance by FY 94. The Army, as executive agent, is rehosting the Janus and JCM models from VAX/VMS operating systems to a UNIX open-systems environment with POSIX compliance. The Navy is rehosting ACAAM, OSD is moving MIDAS from the VAX/VMS to

a UNIX open-system, and the Joint Staff is doing the same for the Force Structure Assessment System (FSAS) and MEPES. Many of the rehosted models could support the warfighter through applications on GCCS.

*Model Development.* The Services are well along in developing the next generation of joint combat models. The Air Force is developing NASM, the Army is developing Warfighters' Simulation 2000 (WARSIM 2000), and the Marine Corps is developing MTWS. These efforts are heavily coordinated and will establish the new functional relations that will be the standard for M&S for the foreseeable future, particularly in the joint training arena, since interoperability is factored into the model design. In an initiative to incorporate Special Operations Forces (SOF) into models, USSOCOM, through a project sponsored by DMSO, is developing a Joint Special Operations Task Force (JSOTF) staff trainer. A large portion of that study involves the evaluation of theater combat models for SOF applications. Once those models have been evaluated and candidates identified, then SOF functionalities will be integrated into them. It is intended that host models will support analysis as well as serve as drivers for SOF exercises and war games. The Defense Nuclear Agency is developing the Integrated Theater Engagement Model (ITEM), a theater-level campaign model with extensive joint operations analysis capabilities applicable to both nuclear and conventional scenarios. The Joint Staff is developing actions to incorporate opposing force unique strategy, doctrine, and training factors into models. The starting point is the set of nations covered in the Defense Planning Guidance illustrative scenarios. A supporting digital characteristics and performance data base, covering associated systems and equipment, is now in acceptance testing.

*Data Bases.* Common and reusable data bases developed by various nodes of excellence and

accessible to DMS-users are required to meet the growing demand for JM&S. Both USCENTCOM and the Joint Staff have started work in this area. The Conventional Force Data Base (CFDB) was developed at USCENTCOM under the sponsorship of the Joint Staff, J-8, to gather unit, personnel, and equipment data from multiple DOD sources; process the data into a useable form; and store it on a single system for support of the JM&S community. CFDB shortens the data base build process by providing a single data base, automatically updated, from which data can be extracted and organized for any model used by USCENTCOM and for many of the models used by other combatant commands. Although many types of data still are not included in CFDB, the system was declared fully operational on 1 April 1992.



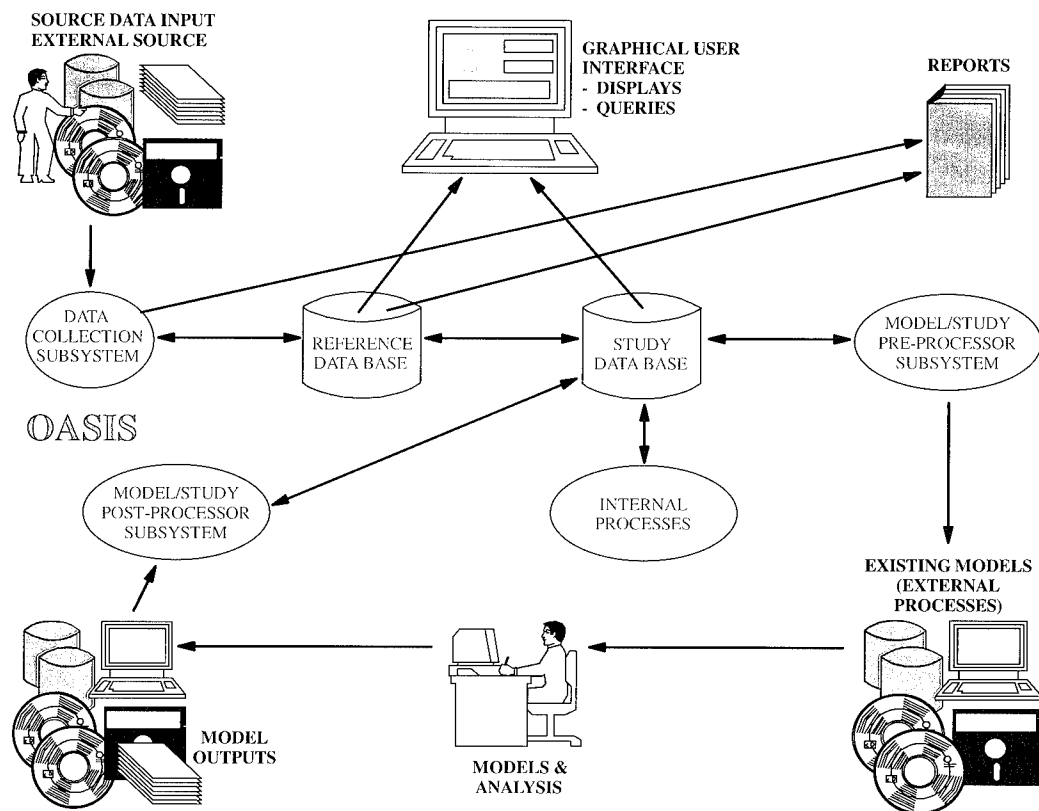
The Operations Analysis and Simulation Interface System (OASIS) is a data base management system designed to improve data processing and management for J-8 analysis. OASIS will improve data accessibility, enhance interoperability, decrease redundancy, improve time management, and support data standardization. It will support requirements for analysis of conventional and strategic forces, system requirements, and program and budget issues. Functionality for strategic forces analysis

and FROBAK (Front End/Back End) and AEM (Arsenal Exchange Model) pre-processor data support requirements became operational in May 1993. Other data sources and model pre-processing capabilities will be incorporated incrementally.

*Data Base Interface.* The Dynamic Analytic Replanning Tool (DART), developed by USTRANSCOM and ARPA, is a data base processing and management tool for time-phased force deployment data (TPFDD) analysis and became available in FY 92. The Master Simulation Data System (MSDS) is a data-driven system, designed and developed by USCENCOM to process CFDB and Defense Intelligence Agency (DIA) Order of Battle source data into specific formats required by models and simulations. MSDS provides the model analysts with the capability to build scenario data bases with the required force structure, equipment, and personnel, and to process them

into CBS, TACWAR, JCM, or the Joint Theater Level Simulation (JTLS) model-ready input files. Using CFDB and DIA data, the MSDS cuts data base development time from months to days.

*Tools and GUIs.* The Joint Staff Joint Analysis and Assessment Tools Program will facilitate the modification of existing software applications and the joint development of shared-use analytic tools and capabilities. In conjunction with the Joint Staff action to convert J-8 models to open system environments, many XView and NeWS GUIs have been converted to OPEN LOOK Intrinsic Toolkit (OLIT), resulting in more robust and more supportable applications. J-8 is considering adopting the MoOLIT tool kit, which provides either the MOTIF or OPEN LOOK look-and-feel or the emerging Common Open Software Environment (COSE) under development by a newly formed coalition of UNIX vendors.

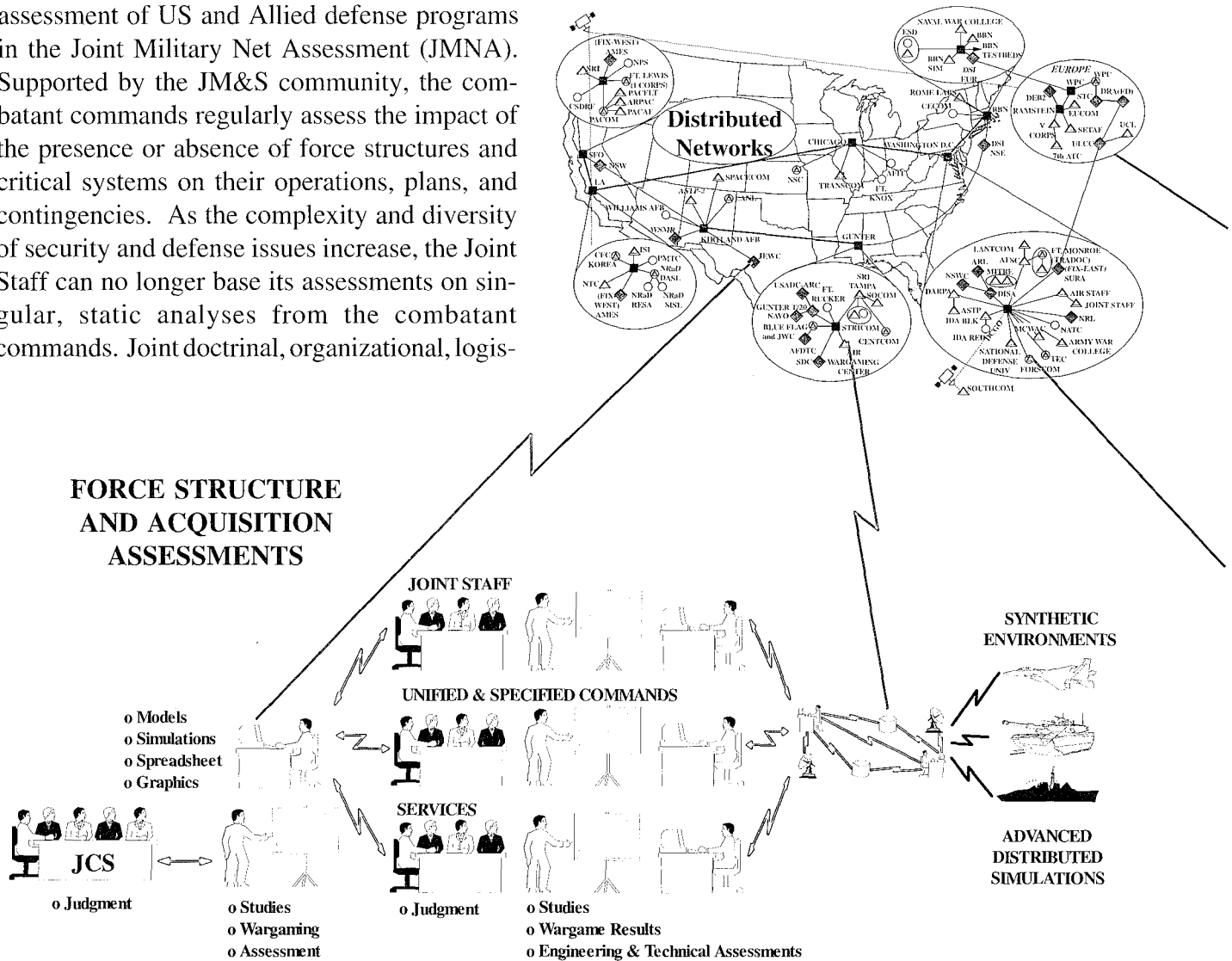


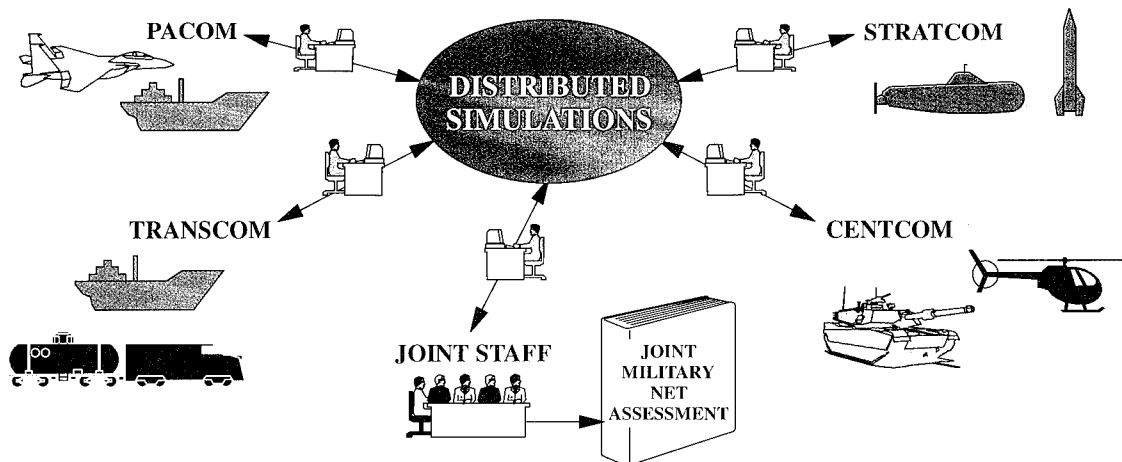
The JM&S community will collaborate in assessments supporting policy, strategy, doctrine, acquisitions, logistics, and operational concepts and supplement the combatant commands' indigenous M&S capabilities to meet joint training objectives.

**Joint Assessments.** Currently, the JM&S community provides stovepipe support for most of the assessment processes in the Joint Strategic Planning System--threat estimates for the National Military Strategy Document, evaluation of Service program objective memoranda (POMs) in the Chairman's Program Assessment, and assessment of US and Allied defense programs in the Joint Military Net Assessment (JMNA). Supported by the JM&S community, the combatant commands regularly assess the impact of the presence or absence of force structures and critical systems on their operations, plans, and contingencies. As the complexity and diversity of security and defense issues increase, the Joint Staff can no longer base its assessments on singular, static analyses from the combatant commands. Joint doctrinal, organizational, logis-

tic, and training issues need to be broadly considered by widening the reviews to all supported and supporting combatant commands.

**Distributed Joint Military Net Assessment Support.** The JMNA is the CJCS assessment of the military forces and capabilities of the United States and its allies against potential adversaries given the current strategic environment, national security objectives, the President's Budget request, and the Defense Program. Tools used in the JMNA process include previous analyses, current estimates and static comparisons, model-

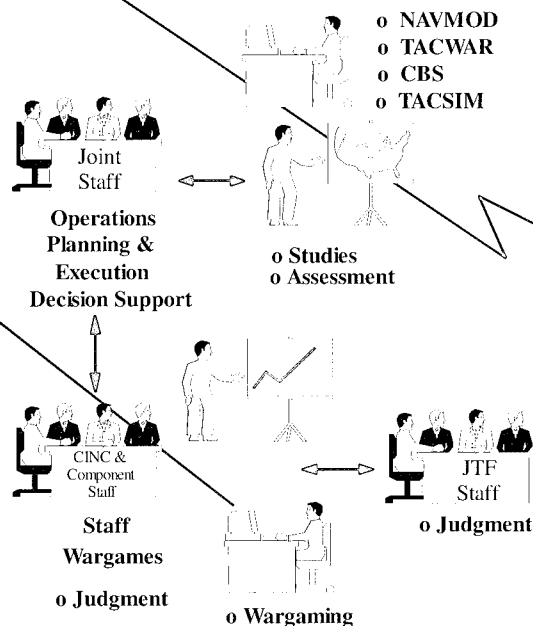




### DISTRIBUTED JMNA PROCESS - FY 95

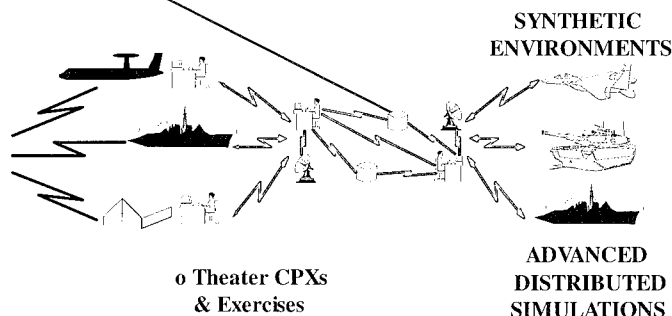
ing, pol-mil gaming and seminars, expert advice, and military judgment of senior leaders. Currently, these tools and the associated methodologies and data bases are independently selected and employed by the JMNA participants. Consequently, they may not be comparable or appropriate for consolidation with other analyses due to differences in base case assumptions or data. Further, the most appropriate tools or methodologies may not be available to each JMNA participant.

The FY 94 JMNA will be electronically transmitted to the combatant commands and video teleconferencing will be used to facilitate joint analysis. The FY 95 JMNA will serve as a testbed to determine the potential of a "Distributed JMNA Process" to correct the problems discussed above. USPACOM, USCENTCOM, USTRANSCOM, USSTRATCOM, and the Joint Staff will participate in collaborative analysis supported by DMS for the FY 95 JMNA. If this test establishes the validity of the Distributed JMNA Process, the near-term objective will be the participation of the entire JM&S community. The long-term objective will be participation of the JM&S community in all phases of the Joint

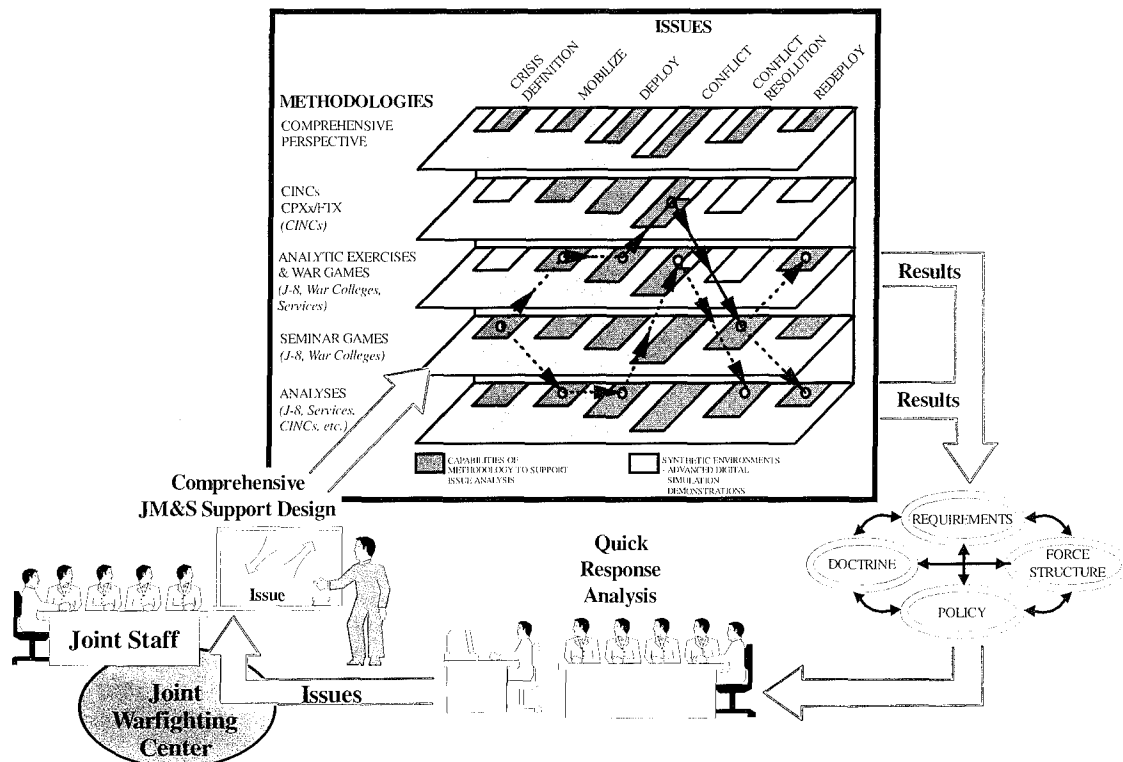


### OPERATIONS PLANNING

### JOINT READINESS EXERCISES SUPPORTED BY DMS







## JOINT SUPPORT OF LAM IMPLEMENTATION CONCEPT

Strategic Planning System and appropriate participation in the PPBS.

*Joint Support to the Louisiana Maneuvers.* The Army's Louisiana Maneuvers (LAM) program is the process by which its senior leadership will identify and work salient Doctrine, Organization, Training, Leader Development, Materiel Requirement, and Soldier Support issues that must be resolved for the Army's transition into the 21st Century. This effort will exploit existing Joint Staff, combatant command, and Service sponsored computer-assisted exercises and analytical war games to work these issues. It will also serve as a salient catalyst for JM&S development, demonstration, and employment appropriate to the Army issues being examined.

LAM's General Headquarters Exercise (GHQ'X) 93 linked two combatant command exercises, ULCHI FOCUS LENS (USFK) and FUERTAS DEFENSAS (USSOUTHCOM) in August 1993 as a means to exercise the Army Staff and create

a situation where it must allocate scarce resources to support two concurrent regional requirements. Additional participants were USTRANSCOM, FORSCOM, and the Defense Logistics Agency. The Army is incorporating lessons learned from GHQ'X 93 into subsequent annual GHQ'Xs and other combatant command exercises with which LAM will associate.

*Advanced Distributed Simulations (ADS) and the Defense Science Board (DSB) Initiatives.* The JM&S community will review and selectively investigate the DSB's proposal for a series of experiments and demonstrations that develop and illustrate the capabilities of ADS to support activities improving:

- o Training readiness for both active and reserve forces.
- o Proficiency to plan and conduct joint operations.
- o Model and simulation support of acquisition assessments.

ADVANCED DISTRIBUTED SIMULATION DEMONSTRATION	OBJECTIVE		
	Improve Readiness	Joint Operational Proficiency	Modeling and Simulation Support to Acquisition Assessments
JTF Campaign Planning & Training	X	X	X
Interactive Exercise at Home Stations	X	X	
Integrated National Guard Brigade Training	X	X	
CINC Wargaming Networking	X	X	
Combined Arms C2			X
Theater Air & Missile Defense			X
Suppressing Critical Mobile Targets		X	X
Networked Battle Games	X		
Battlefield Visibility			X
Network Training & Test Ranges	X	X	X
Realistic Electronic Combat Test & Training	X	X	
Improving Warfighting C4I Interface		X	X

### DSB INITIATIVE--OBJECTIVES AND SUPPORTING DEMONSTRATIONS

ADS demonstrations will be conducted through the direct involvement of the user community with the development community. The Services and combatant commands will be actively involved as "demanding customers," and the integration of existing facilities, programs, and home unit participation will be emphasized. The Joint Staff lead for this action will be the JWFC. Demonstrations will emphasize new or advanced ADS applications, including virtual reality and transparent technological support. Initial demonstrations will establish an infrastructure of simulators, virtual battlefields, and/or constructive models to serve as a foundation for future demonstrations and applications. The first demonstrations also will be low risk, focused on successfully demonstrating ADS in joint operational applications. They will incorporate systems normally used in war with emphasis on joint C4I and logistics. Succeeding demonstrations will be built on and reinforce initial successes.

The Army's Training and Doctrine Command (TRADOC) Analysis Command (TRAC) is supporting the DSB initiatives with a project to enable Simulation Network (SIMNET) derived simulators to dynamically interact within the battlefield created by the Army's Janus combat simulation. The project has successfully broadcast the terrain and events taking place within Janus to SIMNET workstations where they are graphically displayed. The next phase will enable events occurring in SIMNET to update the Janus simulation during its execution.

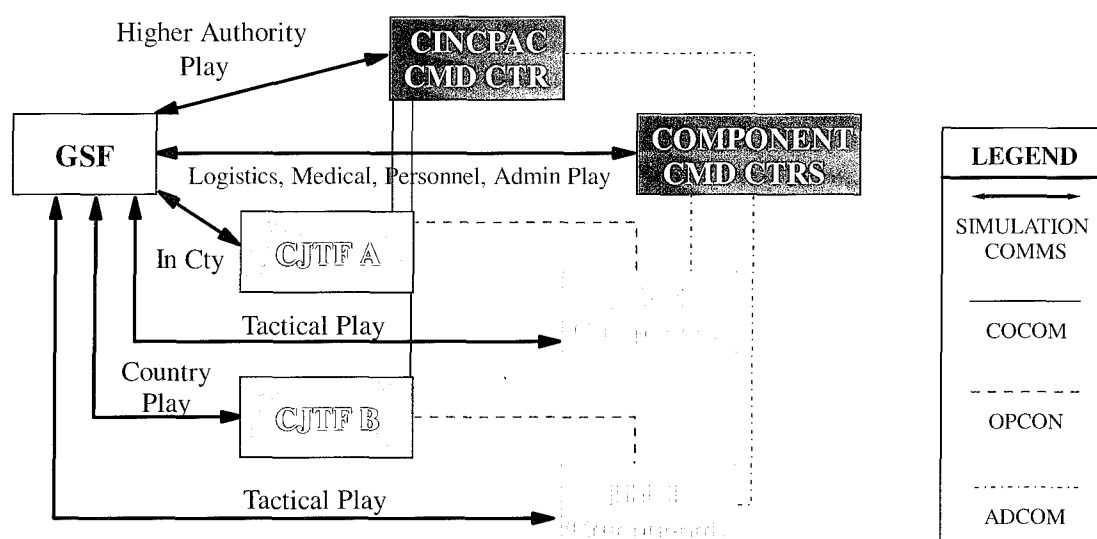
TRAC is also working on a proof-of-principle to develop the protocols and methodologies to integrate Eagle, an object-oriented, corps/division-level combat model, and SIMNET's environment of networked, manned simulators. This vertical linkage will enable Eagle to coordinate the actions of live crews in system simulators and to represent the effects of human involvement in combat, as opposed to simply representing the effects of equipment.

*Joint Training Requirements.* The development of joint training methodologies and their required DMS support are driven by training objectives and scenarios. Today, the renewed emphasis on regional contingencies and missions at the lower and middle-conflict levels are generating training objectives and scenarios that cannot be wholly supported by current JM&S capabilities indigenous to the combatant commands. The continuing reduction of forward-deployed forces creates a training requirement for participation of CONUS-based forces in regional contingencies. Either additional resources must be spent for deployment of CONUS forces to participate in joint readiness exercises or alternative forums for the participation of CONUS forces must be provided. The following discussions of USPACOM's Joint Task Force Simulation, USSOUTHCOM's work in inter-agency pol-mil wargames, and FORSCOM's joint readiness exercise support illustrate some ongoing JM&S projects in support of joint training.

*Joint Task Force (JTF) Simulation (JTFS).* USPACOM has established a theater simulation policy to train combatant command, JTF, and Service component commanders, and their respective staffs, for low- to mid-intensity

operations. The JTFS goal is to establish an air-land-maritime distributed simulation system for JTF and USPACOM headquarters command and staff training using actual C4I systems and procedures. The mature JTFS will comprise a suite of models that supports training in all phases of crisis action procedures. During the execution phase, the JTFS will employ an interactive, two-sided, force-on-force computer-driven simulation run by controller teams who, as role players, report results to the training audience. To enhance training fidelity, JTFS attempts to be transparent to the trainee by being distributed over real-world C4I systems to the command centers.

The architecture of JTFS mirrors the two-tier C2 concept of the JTF. It provides simulations at the operational level allowing interaction between the combatant commands and the component command centers. Simultaneously, the JTFS architecture provides simulation at the tactical level, allowing interaction between the JTF staff and the command centers of its service components "in country." The evolving JTFS is being employed to support the TEMPO BRAVE series of exercises.



**JTFS MATURE CAPABILITY - SIMULTANEOUS SIMULATIONS**

*Distributed Interagency Pol-Mil Games.* Training and planning for new peacetime missions--disaster relief, peace-keeping operations, drug interdiction--are requiring the development and use of distributed, pol-mil, interagency gaming. The premier example is USCINCSOUTH's Counterdrug Modeling and Simulation System Structure.

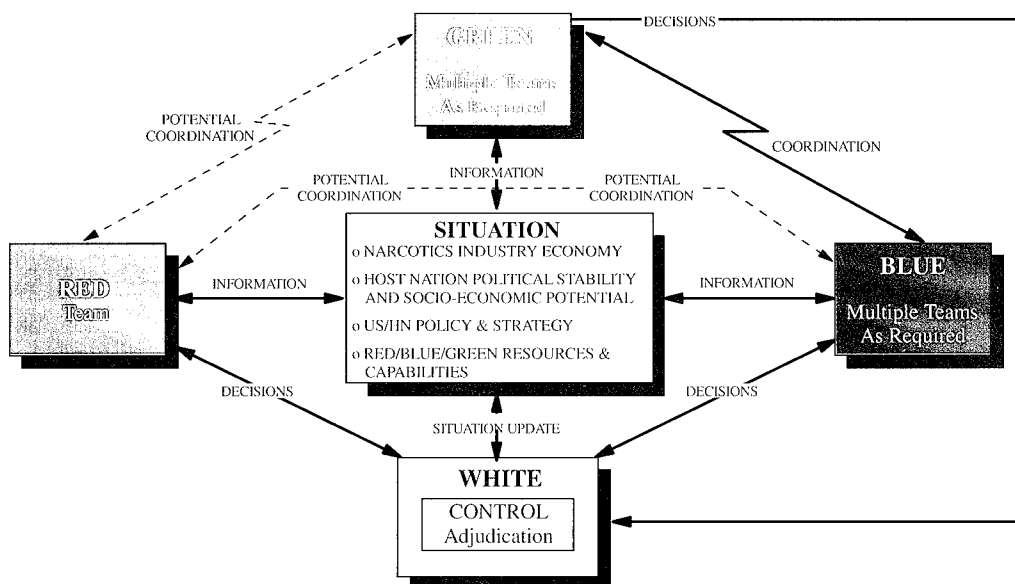
The objectives of the initiative are to:

- o Enhance interagency operations.
- o Improve understanding of the threat through a dedicated red team.
- o Enhance host-nation participation and regional coordination.
- o Improve USSOUTHCOM staff planning and execution of counterdrug support activities.
- o Influence the development of host action capabilities.

The initiative involves the Departments of Defense, State, Transportation, and Treasury, as well as the Drug Enforcement Administration and the intelligence community. It is also multinational with the participation of Bolivia and

Columbia in host-nation roles. It requires modeling the drug industry, developing a professional red team, and establishing a teleconferencing capability to permit play from remote sites. The game must represent US interagency (Blue), drug industry (Red), host nation (Green) and other US policy makers (white/control). Development capitalizes on existing models and concepts with support and assistance from other JM&S agencies and organizations. The goal is to achieve a fully integrated and distributed game by 1994.

*Joint Readiness Exercises Support.* The current and planned use of DMS support in joint exercises provides the imperative for the evolution of the DSI from its current state of development to a fully operational status. DSI capability to support training exercises will be expanded in ULCHI FOCUS LENS 94. JWFC will support USPACOM's TEMPO BRAVE and KEEN EDGE exercises with DMS. JWFC is also providing evolving DMS support to FORSCOM's quarterly air defense Joint System Training Exercises (JSTE). USACOM and USPACOM plan to participate in alternating JSTEs.



**COUNTERDRUG MODELING AND SIMULATION SYSTEM STRUCTURE**

***Joint Staff***

	<u>Phone</u>	<u>DSN</u>
J-4, Mobility Division (J4/MOB)		
Mobility and Logistics	(703) 697-6110	227-6110
J-6, Resource, Planning, and Evaluation Division (J6E)		
M&S	(703) 697-8590	227-8590
J-6, C4 Architecture & Integration Division (J6I)		
C4IFTW	(703) 614-8787	224-8787
J-7, Joint Simulation Division (J7/JSID)		
Policy	(703) 695-3047	225-3047
Joint Test/Evaluation	(703) 693-3418	223-3418
Joint Warfighting Center (JWFC-CC)	(904) 884-7720	579-7720
J-8, Technical Support and Operations Division (J8/TSOD)		
Applications	(703) 697-7824	227-7824
Data Bases	(703) 697-8899	227-8899
H/W Configuration	(703) 693-4614	223-4614
J-8, Resources, Policy and Programs Division (J8/RPPD)		
Contracts	(703) 614-7881	224-7881
CAAS	(703) 693-4608	223-4608
MAPP	(703) 695-1763	225-1763

***DOD***

<u>Office</u>	<u>Phone</u>	<u>DSN</u>	
ARPA	ASTO	(703) 696-2309	226-2309
BMDO	GSS	(703) 693-1594	223-1594
DIA	PAN-2	(202) 373-8026	243-8026
DISATBC		(703) 487-8020	364-8020
DLA	CAI	(703) 274-6328	284-6328
DMA	TID	(703) 285-9236	356-9236
DMSO		(703) 998-0660	None
DNA	DNA/OPNA	(703) 325-7177	221-7177
NDU	NDU-NSS-WGSC	(202) 475-1251	335-1251

***Services***

<u>Office</u>	<u>Phone</u>	<u>DSN</u>	
Army	MISMA	(703) 607-3384	327-3384
Navy	N-812	(703) 695-3797	225-3797
Air Force	XOM	(703) 695-1835	225-1835
Marine Corps	MCMSMO	(703) 640-2498	278-2498

***CINCs***

<u>Office</u>	<u>Phone</u>	<u>DSN</u>	
USACOM	J73	(804) 444-1801	564-1801
USCENTCOM	CCCA	(813) 830-6210	968-6210
USEUCOM	ECCS-AS	011-49-711-680-5354	(314) 430-5354
USPACOM	J53	(808) 477-5371	(315) 477-5371
USSOCOM	SOJ5-C	(813) 830-5303	968-5303
USSOUTHCOM	SCJ5-RW	011-507-82-3508	(313) 282-3508
USSPACECOM	AN	(719) 554-5835	692-5835
USSTRATCOM	J53	(402) 294-5839	271-5839
USTRANSCOM	TCJ5-SC	(618) 256-5109	576-5109
FORSCOM	AFOP-MS	(404) 669-5592	367-5592
CFC-Korea	CFCD-ED-BSC	011-82-2-7915-8020	(315) 725-8020

***Joint  
Modeling  
and  
Simulation  
Points of  
Contact***

